OPTIMIZED DESIGN

OF

HIGH POWER TRANSFORMER

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The thesis titled **"Optimized Design of High Power Transformer",** submitted by Md. Chand Ali (EEE 03306071), Md. Junnun Misree(EEE 03306064),Md. Jashim Uddin (EEE 03306043), Md. Sharif Belal (EEE 03306068) to the following members of the board of examiners of the department of Electrical and Electronics Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronics Engineering on January 2010 and has been accepted as satisfactory.

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Declaration

It is declare that this thesis has been prepared by us for very first time and it has not been published at any kind of publication else. Information has been quoted from any source have been properly acknowledged by mentioning the author's reference at appropriate places. This thesis is submitted for our partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronics Engineering [B.Sc.in EEE].

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ABSTRACT

A lot of efforts have been directed for optimization of electrical machine design. Among them the diverse types of electrical machines, the transformer and motor are commonly used ones. However their design procedures are changing and complexity of ne aspects of their applications is growing. One of the objectives of this thesis work is to find out the techniques of improving some vital parameters and characteristics of three phase high power transformers. For the transformers these are reduction to rational value of leakage flux and optimum designing of electromagnetic shield, loss performances. The large number of non-explicit expression has been incorporated in the standard routine to obtain compact user friendly software, capable of giving the design solution in minimum computer time. The standard software available for optimization of mathematical functions is not directly applicable for machine design. The objective functions cannot be uniquely formulated and in some cases compound objective functions including effective cost, efficiency, weight, temperature rise, mechanical and electromagnetic withstanding capability, noise and loss reduction, harmonics, speed control etc, have to be formulated.

The constraint functions are highly nonlinear and cannot be expressed as explicit functions of the decision variables; even the decision variables are not uniquely defined. The non-explicit objective functions and constraint s are properly fed to the optimization program to get the solution in most handy form. Designing has been carried out for various capacities of high power transformers to assess the effectiveness of the software and it limits of covered ranges of size and power of the machine. The optimization program based on Quasi-Newton method has been used because of its capability of fast convergence, handing of large scale problems and giving global minimum point. The developed software based on inclusion of new aspects of designing may be fruitfully used for machine designing purpose in our local electrical machine manufacturing plants.

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LIST OF FIGURE

LIST OF SYMBOLES

S	Rating of Transformer
v_p	Voltage rating in high voltage winding, volt
v_s	Voltage rating in low voltage winding, volt
p_f	Rated power factor of transformer
f	Supply frequency, Hz
n_{ph}	Number of phases
a_i	Area of core, mm^2
d_c	Diameter of core, mm
d_y	Depth of yoke, mm
h_y	Height of yoke, mm
T_s	Number of turns in l.v. windings mm
I_{pp}	Phase current in high voltage winding, Amp
P_i	Iron loss in conventional design, KW
P_{total}	Total loss in conventional design, KW
η_{tfmr}	Efficiency of transformer in conventional design, %
V_r	Voltage regulation, %
i_o	Percentage of no lode current, %
b_y	Flux density in yoke, Wb/mm^2
p_o	Total Iron loss, kw
ω	The angular frequency, rad/s
σ	The conductivity of the aluminum, Siemens/m
p	Number of poles
N	Speed of motor
Φ	Flux per pole, Wb
T_s	Number of turns per phase
E_s	Supply voltage, volt
B_{st}	Flux density in stator teeth, Wb/m^2
B_{sc}	Flux density in stator teeth, Wb/m^2
δ_e	Current density in end ring, mm
δ_b	current density in rotor bar, Amp/mm^2
p_{si}	Total iron loss, Watt
p_o	No lode loss, Watt

i_o	No lode current, Amp
x_m	Magnetizing leakage reactance, ohm
p_{rc}	Total copper loss at rotor, Watt
p_{cu}	Total copper loss, Watt
η	Full lode efficiency, %
P	Total loss of motor, Watt
λ_s	Specific slot performance
k_o	Overhang factor,
k	Skew factor
φ	Power factor angle
p_{fn}	Full lode power factor
ω	Angular frequency, Hz
i_{fl}	Full lode current, amp
i_{st}	Starting current, amp
Θ_s	Temperature rise in stator surface, ^{o}cw
w_{ti}	Total weight in iron, kg
k_i	weight per m^3 of iron,kg/m^3
w_{tc}	Total weight of copper in stator winding, Kg
k_c	Weight per m^3 of cupper, Kg/m^3